FLUKE®

Service Manual

87 & 89 Series IV

True RMS Multimeter

Change #1

On page 21, Table 4, step 50, under Display,

Change: -0.02 0.02

To: -0.20 0.20

Change #2

On page 28, Table 6, make the following changes:

Change: Access Door, Battery/Fuse MP 14 658446 1

To: Access Door, Battery/Fuse MP 14 666446 1

Add the following:

Fluke 89-4-8015, CSA Label	MP33	669884	1
Fluke 89-4-8016, Shock Absorber for Battery Door	MP27	674850	1

Change #3

On page 20, Table 4, make the following changes:

Change the Upper Display Limit for step 38,

From 0.8000

To: 1.1000

Change the Lower & Upper Display Limits for step 25,

From: 946.0 1054.0

To: 936.0 1064.0

On page 21, Table 4, change the Lower & Upper Display Limits for step 51,

From: 0.2422 0.2578

To: 0.2442 0.2558

Change #4

On page 19, Table 4, change the Lower & Upper Limits for step 13:

From: 29.63 30.37

To: 29.66 30.34

FLUKE®

87 & 89 Series IV

True RMS Multimeter

Service Manual

PN 676137
May 1999
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Table of Contents

Title	Page
Introduction	1
Precautions and Safety Information	2
International Symbols	2
Safety Information	3
Specifications	4
Accuracy	4
Feature Summary	4
General Specifications	5
Basic Specifications	6
AC Voltage and Decibel Specifications	6
AC Current Specifications	7
DC Current Specifications	7
Resistance and Conductance Specifications	8
Capacitance and Diode Function Specifications	8
Frequency, Duty Cycle, & Pulse Width Specifications	8
Temperature Specifications	9
MIN MAX Recording Specifications	9
Frequency Counter Sensitivity	9
Burden Voltage (A, mA, µA)	10
Input Characteristics	10
Required Equipment	11
Basic Maintenance	12
Opening the Meter Case	12
Removing and Reinserting the Circuit Board Assembly	12
Replacing the LCD	13
Reassembling the Meter Case	14
Testing Fuses (F1 and F2)	14
Replacing Fuses	15
Replacing the Batteries	15
Cleaning	16
Performance Tests	17
Testing the Display	17
Backlight Test	17
Current Terminal Sensing Test	17
Keypad Test	18
Verification of the IR Communication Port	18

Testing Temperature 18
Testing Voltage, Current, Resistance, Capacitance and Diode Functions 19
Calibration 22
Keypad Interface 22
General Procedure 23
Special Requirements 24
Calibration Inputs 24
Remote Interface 26
Temperature Calibration 26
Setup 26
Procedure 27
Re-Programming Serial Number or Model Number 27
Parts and Accessories 28

List of Tables

Table	Title	Page
1.	International Symbols	2
2.	Required Tools and Equipment	11
3.	Temperature Test Input and Display	18
4.	Performance Test Steps	19
5.	Calibration Inputs	24
6.	Replacement Parts and Accessories	28

List of Figures

Figure	Title	Page
1.	Removing LCD Mask to Access LCD	13
2.	Testing the Current Fuses	15
3.	Battery and Fuse Replacement	16
4.	Display Test	17
5.	Locating Recessed Calibration Button	22
6.	Calibration Display	23
7.	Replacement Parts and Accessories	29

Introduction

⚠ Warning

To avoid shock or injury, do not perform the verification tests or calibration procedures described in this manual unless you are qualified to do so.

The information provided in this document is for the use of qualified personnel only.

Caution

The 87 & 89 Series IV Multimeters contain parts that can be damaged by static discharge.

Follow the standard practices for handling static sensitive devices.

The information in this manual deals with the Fluke Models 87 & 89 Series IV True RMS Multimeters, (hereafter referred to as "the meter"). Information provided includes:

- Precautions and safety information
- Specifications
- Basic maintenance (cleaning, replacing the battery and fuses)
- Performance test procedures
- Calibration and calibration adjustment procedures
- Accessories and replaceable parts

For complete operating instructions, refer to the *Model 87 & 89 Series IV Users Manual.*

To contact Fluke, call:

1-888-993-5853 in USA and Canada

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Precautions and Safety Information

Use the Meter only as described in the *Users Manual*. If you do not do so, the protection provided by the Meter may be impaired.

Read the "Safety Information" page before servicing this product.

In this manual, a **Warning** identifies conditions and actions that pose hazard(s) to the user; a **Caution** identifies conditions and actions that may damage the Meter or the test instruments.

International Symbols

International symbols used on the Meter and in this manual are explained in Table 1.

Table 1. International Symbols

Symbol	Meaning	Symbol	Meaning
	Alternating current		Earth ground
	Direct current		Fuse
	Alternating or direct current		Conforms to European Union directives
	Refer to the manual. Important information.		Conforms to relevant Canadian Standards Association directives
	Inspected and licensed by TÜV Product Services.		Double insulated
	Battery		Underwriters Laboratories, Inc.

Safety Information

⚠Warnings and Precautions

To avoid possible electric shock or personal injury, follow these guidelines:

- Do not use the Meter if it is damaged. Before you use the Meter, inspect the case. Look for cracks or missing plastic. Pay particular attention to the insulation surrounding the connectors.
- Inspect the test leads for damaged insulation or exposed metal. Check the test leads for continuity. Replace damaged test leads before you use the Meter.
- Do not use the Meter if it operates abnormally. Protection may be impaired. When in doubt, have the Meter serviced.
- Do not operate the Meter around explosive gas, vapor, or dust.
- Do not apply more than the rated voltage, as marked on the Meter, between terminals or between any terminal and earth ground.
- Before use, verify the Meter's operation by measuring a known voltage.
- When measuring current, turn off circuit power before connecting the Meter in the circuit. Remember to place the Meter in series with the circuit.
- When servicing the Meter, use only specified replacement parts.
- Use caution when working above 30 V ac rms, 42 V peak, or 60 V dc. Such voltages pose a shock hazard.
- Avoid working alone.
- When using the probes, keep your fingers behind the finger guards on the probes.
- Connect the common test lead before you connect the live test lead. When you disconnect test leads, disconnect the live test lead first.
- Remove test leads from the Meter before you open the battery door.
- Do not operate the Meter with the battery door or portions of the cover removed or loosened.
- To avoid false readings, which could lead to possible electric shock or personal injury, replace the batteries as soon as the low battery indicator (+▬) appears.
- Use only type AA batteries, properly installed in the Meter case, to power the Meter.

Caution

To avoid possible damage to the Meter or to the equipment under test, follow these guidelines:

- Disconnect circuit power and discharge all high-voltage capacitors before testing resistance, continuity, diodes, or capacitance.
- Use the proper terminals, function, and range for your measurements.
- Before measuring current, check the Meter's fuses and turn power OFF to the circuit before connecting the Meter to the circuit.

Specifications

Accuracy

Accuracy is specified for a period of one year after calibration, at 18 °C to 28 °C (64 °F to 82 °F), with relative humidity to 90 %. Accuracy specifications are given as:

± ([% of reading] + [number of least significant digits])

AC mV, AC V, AC µA, AC mA, and AC A specifications are ac-coupled, true rms and are valid from 5 % of range to 100 % of range. AC crest factor can be up to 3.0 at full-scale, 6.0 at half-scale, except the 3000 mV and 1000 V ranges where it is 1.5 at full scale, 3.0 at half-scale.

Feature Summary

Feature	Description
Dual Digital Displays **Analog Bar Graph**	Primary: 50,000 counts Secondary: 5,000 count Bar graph: 51 segments, updates 40 times/second
Backlight with 2 brightness adjustment	Bright-white backlight for clear readings in poorly lighted areas
Fast Autorange	Meter automatically selects best range
AC+DC true rms, ac rms specified to 100 kHz	Choices for AC only, AC and DC dual display, or AC+DC readings
dBm, dBV	User-selectable impedance references for dBm
AutoHOLD	Holds readings on display
Continuity / Open test	Beeper sounds for resistance readings below threshold, or to indicate a momentary open circuit
Fast Bar Graph	51 segments for peaking and nulling
Duty cycle / Pulse width	Measure the time signal is on or off in % or milliseconds
MIN MAX Mode **FAST MN MX with 24-hour time stamp**	Record maximum, minimum, and average values. 24-hour clock for MAX or MIN, elapsed time for AVG. FAST MN MX captures peaks to 250 µsec.
Close-Case Calibration	No internal adjustments needed
Battery / Fuse Access Door	Battery or fuse replaceable without voiding calibration
Hi-Impact Overmolded Case	Protective holster features

General Specifications

Maximum Voltage between any Terminal and Earth Ground	1000 V ac/dc
Surge Protection	8 kV peak per IEC 1010.1-92
⚠Fuse Protection for mA or μA inputs **⚠Fuse Protection for A input**	44/100 A, 1000 V FAST Fuse 11 A, 1000 V FAST Fuse
Display (LCD)	Digital: 50000/5000 primary display, 5000 counts secondary display; updates 4/second. Analog: 51 segments, updates 40/second.
Temperature	Operating: -20 °C to +55 °C; Storage: -40 °C to +60 °C
Altitude	Operating: 2000 m; Storage: 10,000 m
Temperature Coefficient	0.05 x (specified accuracy) / °C (<18 °C or >28 °C)
Electromagnetic Compatibility (EMC)	Susceptibility and Emissions: Commercial Limits per EN61326-1
Relative Humidity	0 % to 90 % (0 °C to 28 °C); 0 % to 70 % (28 °C to 55 °C)
Battery Type	4 AA Alkaline, NEDA 15A or LR6
Battery Life	72 hrs typical (with backlight off)
Shock Vibration	Per MIL-T-PRF 28800 for Class II instruments
Size	3.94 in x 8 in x 1.97 in (10.0 cm x 20.3 cm x 5.0 cm) (Not Including Accessory Mount)
Weight	1.2 lbs (545 g)
Case Sealing	IP-42 per IEC 529, Section 3
Warranty	Lifetime
Calibration Interval	1 year
Compliances	Complies with ANSI/ISA S82.01-94, CSA 22.2 No. 1010.1-92 to 1000 V Overvoltage Category III, Pollution Degree 2.*
Certifications (listed and pending)	CSA per standard CSA/CAN C22.2 No. 1010.1-92 UL per standard UL3111-1 (pending) TÜV per standard EN 61010 Part 1-1993 (pending)

*CAT III: OVERVOLTAGE (Installation) Category III, Pollution Degree 2 per IEC1010-1 refers to the level of Impulse Withstand Voltage protection provided. Equipment of OVERVOLTAGE CATEGORY III is equipment in fixed installations. Examples include electricity meter and primary over-current protection equipment.

Basic Specifications

Function	Ranges/Description
DC Voltage	0 to 1000 V
AC Voltage, true RMS	15 mV to 1000 V – 100 kHz bandwidth
Basic Accuracy	DC voltage: 0.025 % AC voltage: 0.4 %
DC Current	0 to 10 A (20 A for 30 seconds)
AC Current, true RMS	25 µA to 10 A (20 A for 30 seconds)
Resistance	0 to 30 MΩ
Conductance	0 to 50 nS
Capacitance	0.001 nF to 50 mF
Diode Test	3.1 V
Temperature	–200 °C to 1350 °C (–328 °F to 2462 °F)
Frequency	0.5 Hz to 1000 kHz
LOGGING Intervals (Model 89 only)	At least 288 intervals may be stored. Up to 700 unstable event values are automatically added to LOGGING memory for viewing only through optional PC software. Additional intervals will be logged if the signal is stable.
SAVE Readings (Model 89 only)	Up to 100 readings may be saved by the user in a memory separate from LOGGING memory. These readings may be viewed using VIEW MEM.

AC Voltage and Decibel Specifications

Function	Range	Resolution	Accuracy				
			45Hz-1 kHz	20-45 Hz	1-10 kHz	10-20 kHz	20-100 kHz
AC mV [1,2]	500.00 mV	0.01 mV	0.4 % + 40	2 % + 80	5 % + 40	5 % + 40	6 % + 40
	3000.0 mV	0.1 mV	0.4 % + 40	2 % + 80	0.4 % + 40	1.5 % + 40	6 % + 40
AC V [1,2]	5.0000 V	0.0001 V	0.4 % + 40	2 % + 80	0.4 % + 40	1.5 % + 40	6 % + 40
	50.000 V	0.001 V	0.4 % + 40	2 % + 80	0.4 % + 40	1.5 % + 40	6 % + 40
	500.00 V	0.01 V	0.4 % + 40	2 % + 80	0.4 % + 40	Not specified	Not specified
	1000.0 V	0.1 V	0.4 % + 40	2 % + 80	0.4 % + 40	Not specified	Not specified
dBm 600 Ω	–56 to –6	0.01 dB	0.1 dB	0.2 dB	0.5 dB	0.5 dB	0.5 dB
	–6 to +34	0.01 dB	0.1 dB	0.2 dB	0.1 dB	0.2 dB	0.5 dB
	+34 to +60	0.01 dB	0.1 dB	0.2 dB	0.1 dB	Not specified	Not specified

1. For the 5,000 count mode, divide the number of least significant digits (counts) by 10.
2. A residual reading of 8 to 80 digits with leads shorted, will not affect stated accuracy above 5 % of range.

AC Current Specifications

Function	Range	Resolution	Accuracy			
			45-1 kHz	20-45 Hz	1-20 kHz	20 kHz-100 kHz
AC µA	500.00 µA	0.01 µA	0.75 % + 20	1 % + 20	0.75 % + 20	6 % + 40
	5,000 µA	0.1 µA	0.75 % + 5	1% + 5	0.75 % + 10	2 % + 40
AC mA	50.000 mA	0.001 mA	0.75 % + 20	1% + 20	0.75 % + 20	9 % + 40
	400.00 mA [1]	0.01 mA	.75 % + 5	1% + 5	1.5 % + 10	4 % + 40
AC A	5.0000 A	0.0001 A	1.5 % + 20	1.5% + 20	6 % + 40	Not Specified
	10.000 A [2]	0.001 A	1.5 % + 5	1.5% + 5	5 % + 10	Not Specified

1. 500.00 mA overload for 30 seconds maximum.
2. 20 A overload for 30 seconds maximum.

DC Current Specifications

Function	Range	Resolution	Accuracy	Accuracy Dual Display AC or AC+DC[6]		
			DC	20 - 45 Hz	45 Hz - 1 kHz	1 - 20 kHz
DC mV	500.00 mV	0.01 mV	0.03 % + 2 [4]	2 % + 80	0.6 % + 40	6 % + 40 [3]
	3000.0 mV	0.1 mV	0.025 % + 5 (89 IV) 0.025 % + 10 (87 IV)	2 % + 80	0.6 % + 40	
DC V	5.0000 V	0.0001 V	0.025 % + 10	2 % + 80	0.5 % + 40	
	50.000 V	0.001 V	0.03 % + 3	2 % + 80	0.5 % + 40	
	500.00 V	0.01 V	0.1 % + 2	2 % + 80	0.5 % + 40	Not specified
	1000.0 V	0.1 V	0.1 % + 2	2 % + 80	0.5 % + 40	Not specified
DC µA	500.00 µA	0.01 µA	0.25 % + 20 [5]	7 % + 10	7 % + 10	9 % + 40
	5,000 µA	0.1 µA	0.25 % + 2	1 % + 10	0.75 % + 10	2 % + 40
DC mA	50.000 mA	0.001 mA	0.15 % + 10	1 % + 10	0.75 % + 10	2 % + 40
	400.00 mA [1]	0.01 mA	0.15 % + 2	1.5 % + 10	1.5 % + 10	3 % + 40
DC A	5.0000 A	0.0001 A	0.5 %+ 10	7 % + 20	7 % + 20	12 % + 40
	10.000 A [2]	0.001 A	0.5 %+ 2	1.5 % + 10	1.5 % + 10	3 % + 40

1. mA for 30 seconds maximum.
2. 20 A overload for 30 seconds maximum.
3. DC 5 V range, -3 dB typical @ 10 kHz.
4. In RF field of 3 V/m, add 100 counts from 100 to 120 MHz, 60 counts from 270 to 300 MHz, 40 counts from 320 to 335 MHz.
5. In RF field of 3 V/m, add 500 counts from 80 to 95 Mhz.
6. See AC conversions notes for AC mV and V.

Resistance and Conductance Specifications

Function	Range	Resolution	Accuracy
Resistance [1]	500.00 Ω	0.01 Ω	0.05 % + 10 [3,4]
	5.0000 kΩ	0.0001 kΩ	0.05 % + 2
	50.000 kΩ	0.001 kΩ	0.05 % + 2
	500.00 kΩ	0.01 kΩ	0.05 % + 2
	5.0000 MΩ	0.0001 MΩ	0.15 % + 4 [2]
	30.000 MΩ	0.001 MΩ	1 % + 4 [2]
Conductance	50.00 nS	0.01 nS	1 % + 10

1. For the 5,000 count mode, divide the number of least significant digits (counts) by 10.
2. For relative humidity greater than 70 %, resistance accuracy is 0.5 % over 1 MΩ and 2.5 % over 10 MΩ.
3. In RF field of 3 V/m, add 45 counts from 470 to 1000 MHz.
4. Using Relative Mode (REL) to zero residual reading.

Capacitance and Diode Function Specifications

Function	Ranges	Resolution	Accuracy
Capacitance [1]	1.100 nF	0.001 nF	1 % + 5
	11.00 nF	0.01 nF	
	110.0 nF	0.1 nF	
	1.100 µF	0.001 µF	
	11.00 µF	0.01 µF	
	110.0 µF	0.1 µF	
	1,100 µF	1 µF	
	11.0 mF	0.01 mF	
	50.00 mF	0.01 mF	
Diode Test [2]	3.1000 V	0.0001 V	2 % + 2

1. For film capacitor or better, using Relative mode (**REL** Δ) to zero residual on 1.1 nF range.
2. For the 5,000-count mode, divide the number of least significant digits (counts) by 10.

Frequency, Duty Cycle, & Pulse Width Specifications

Function	Range	Resolution	Accuracy
Frequency	500.00 Hz	0.01 Hz [1]	± (0.005 % + 1)
	5.0000 kHz	0.0001 kHz	
	50.000 kHz	0.001 kHz	
	999.99 kHz	0.01 kHz	
Duty Cycle [2]	10 to 90 %	0.1 %	± (0.12 x voltage range / input voltage x 100 %)
Pulse Width [2]	5.0000 ms	0.0001 ms	± (0.0001 ms + 1)
	50.000 ms	0.001 ms	

1. Reading will be 0.00 for signals below 0.5 Hz.
2. Duty cycle and pulse width operate on repetitive waveforms at 14.5 Hz or greater.

Temperature Specifications

Temperature	–200 to +1350 °C	0.1 °C	± (1% of reading + 1 °C) [1,2]
	–328 to +2462 °F	0.1 °F	± (1% of reading + 1.8 °F) [1,2]

1. Accuracy specification is relative to the user-adjustable temperature offset, and assumes ambient temperature stable to ± 1 °C.
2. For ambient temperature changes of ± 5 °C, rated accuracy applies after 1 hour.

MIN MAX Recording Specifications

MIN MAX AVG	Response: 100 ms to 80 %	Specified accuracy ± 12 counts for changes > 200 ms in duration. (± 40 counts in AC for changes > 350 ms and inputs > 25 % of range)
FAST MN MX	250 µs	Specified accuracy ±100 counts for changes >250 µs in duration [1]

1. For repetitive peaks; 2.5 ms for single events.

Frequency Counter Sensitivity

Input Range	Minimum Sensitivity (RMS Sine Wave) [1]			Approximate Trigger Levels (DC Voltage Function)
	40 Hz to 20 kHz [2]	15 to 40 Hz [3]	20 to 500 kHz [3]	
50 mV (dB only)	15 mV to 3 mV	15 mV	15 mV	± 25 mV
500 mV	50 mV to 30 mV	50 mV	30 mV	35 mV ± 6 mV
3000 mV	1500 mV to 300 mV	2000 mV	2000 mV	170 mV ± 6 mV
5 V	1.5 V to 0.3 V	2 V	2.2 V	1.7 V ± 0.25 V
50 V	15 V to 3 V	15 V	5 V	3.5 V ± 2.5 V
500 V	50 V to 20 V	50 V	50 V	35 V ± 25 V
1000 V	250 V to 100 V	250 V	50 V	35 V ± 25 V

1. Maximum input for specified accuracy = 10 x Range or 1000 V, ac-coupled only. Accuracy: add 1 count
2. Sensitivity improves linearly from 40 Hz to 20 kHz.
3. Useable at reduced sensitivity to 0.5 Hz and 999.99 kHz.

Burden Voltage (A, mA, μA)

Function	Range	Burden Voltage (typical)
mA - μA	500.00 μA	102 μV / μA
	5,000 μA	102 μV / μA
	50.000 mA	1.8 mV / mA
	400.00 mA	1.8 mV / mA
A	5.0000 A	0.04 V / A
	10.000 A	0.04 V / A

Input Characteristics

Function	Input Impedance (Nominal)					
Volts, mV	10 MΩ, < 100 pF					
	Common Mode Rejection Ratio			Normal Mode Rejection		
DC Volts, mV	>100 dB -dc, 50 Hz, or 60 Hz ±0.1%			>90 dB at 50 Hz, or 60 Hz ± 0.1%		
AC Volts, mV	> 90 dB dc to 60 Hz					
	Open Circuit Test Voltage			Full-Scale Voltage		
				To 5 MΩ	30 MΩ + nS	
Ohms	< 5 V			500 mV	3.1 V	
Diode Test	< 5 V			3.1000 V		
	Typical Short-Circuit Current					
	500 Ω	5 kΩ	50 kΩ	500 kΩ	5 MΩ	30 MΩ
Ohms	100 μA	100 μA	10 μA	1 μA	0.1 μA	0.1 μA
Diode Test	0.8 mA typical					

Required Equipment

Required equipment is listed in Table 2. If the recommended models are not available, equipment with equivalent specifications may be used.

Repairs or servicing should be performed only by qualified personnel.

Table 2. Required Equipment

Equipment	Required Characteristics	Recommended Model
Calibrator	AC Voltage Range: 0-1000 Vac Accuracy: ± 0.1 % Frequency Range: 20 Hz – 100 kHz Accuracy: ±3 % DC Voltage Range: 0-1000 Vdc Accuracy: ± 0.006 % Current Range: 0-10A Accuracy: AC mA - ±0.18 % AC A - ± 0.38 % Frequency range: 1 kHz – 20 kHz DC mA - ± 0.06 % DC A - ± 0.125 % Frequency Source: 0.5-20 kHz Accuracy: ± 0.00125 % Amplitude: 1 Volt Accuracy: ± 5 % Ohms Range: 0 Ω - 50 MΩ Accuracy: ± 0.0125 % Capacitance Range: 110.0 nF & 11.00 uF Accuracy: +0.25% Temperature Range: -10 to 350 °C Accuracy: 0.3%	Fluke 5520A
Thermocouple Adapter Accessory	K-type	Fluke 80AK
K-type Thermocouple	K-type, mini-plug on both ends	N/A
Infrared (IR) Adapter		Fluke P/N 690518
87/89 IV Service Software		Fluke P/N 676152

Basic Maintenance

⚠Warning

To avoid electrical shock or personal injury, remove the test leads and any input signals before opening the case or replacing the battery or fuses. To prevent damage or injury, install ONLY batteries or fuses specified for this product.

Opening the Meter Case

Caution

To avoid unintended circuit shorting, always place the uncovered Meter assembly on a protective surface. When the case of the Meter is open, circuit connections are exposed.

To open the Meter case, do the following:

1. Disconnect test leads from any live source, turn the rotary switch to **OFF**, and remove the test leads from the front terminals.
2. Remove the battery door by using a flat-blade screwdriver to turn the battery door fasteners 1/4-turn counterclockwise.
3. The case bottom is secured to the case top by four screws, one at each corner. Remove the screws with a Phillips-head screwdriver.
4. Pull the two halves of the case apart.

Removing and Reinserting the Circuit Board Assembly

The circuit board assembly must be removed to access and replace the LCD.

Caution

The circuit board is extremely susceptible to contamination. Handle it by the input receptacle, fuse clips or edges of the board only. You can use clean surgical gloves to help avoid contamination.

1. Open the Meter case and remove the case bottom to access the circuit board.
2. Remove the two Phillips-head screws securing the circuit board to the case top and lift it out carefully to avoid contamination.
3. To reinsert the circuit board, simply place it into the case top with the LCD display showing through the window.
4. Carefully replace the two Phillips-head screws that connect the circuit board to the case top.

Caution

Do not over-torque the two Phillips-head screws when you reconnect the circuit board to the case top. Doing so may create shielding problems and cause the Meter to give incorrect readings.

Replacing the LCD

If you need to replace the LCD, you will find it easier to leave the LCD assembly attached to the circuit board and access the LCD by removing the LCD mask from the front of the LCD assembly.

1. Remove the circuit board as described under "Removing and Reinserting the Circuit Board Assembly."
2. Carefully insert the tip of a thin screwdriver under the LCD mask at the top of the display as shown in Figure 1.

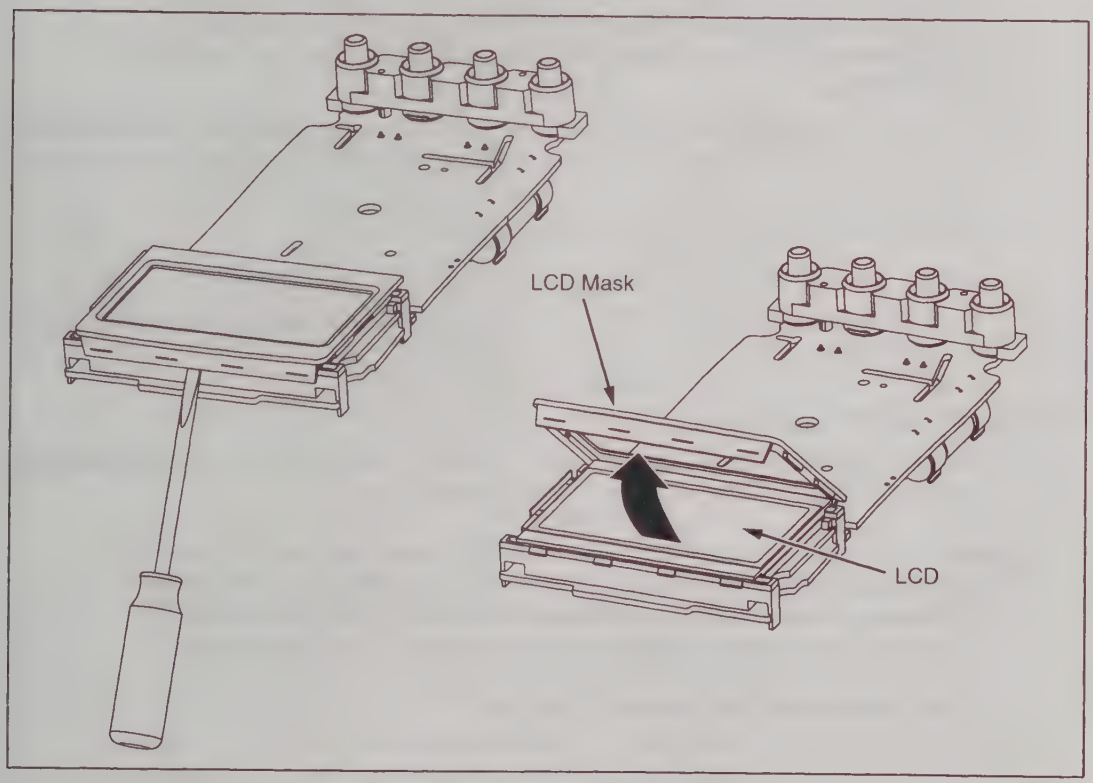


Figure 1. Removing LCD Mask to Access LCD

3. Lift up the LCD mask gently with the screwdriver blade to loosen the mask from the assembly. Be careful to press upward, not inward toward the LCD. By hand, tilt the LCD mask upward to release.
4. Replace the LCD. The LCD must be centered on the platform between the brackets before you replace the LCD mask. If the LCD is improperly aligned, the display may show missing segments or meaningless readings.
5. Reattach the LCD mask by pressing it over the LCD until it snaps into place.

Reassembling the Meter Case

To reassemble the Meter case, do the following:

1. Verify that the rotary switch is in the **OFF** position.
2. Reinsert the circuit board by placing it into the case top with the LCD showing through the window. Carefully replace the two Phillips-head screws that connect the circuit board to the case top.

Caution

Do not over-torque the two Phillips-head screws when you reconnect the circuit board to the case top. Doing so may create shielding problems and cause the Meter to give incorrect readings.

3. Hold the Meter face down and place the case bottom on the case top. Make sure the backlight cable located on the back of the LCD assembly is not caught between the case halves.
4. Reinstall the four screws and the battery door.
5. Secure the battery door by turning the fasteners 1/4-turn clockwise.
6. Go to the "Performance Test" section in this document, and perform the procedures described.

Testing Fuses (F1 and F2)

Before measuring current, test the appropriate fuse as shown in Figure 2. If the tests give readings other than those shown, have the Meter serviced.

⚠Warning

To avoid electrical shock or personal injury, remove the test leads and any input signals before replacing the battery or fuses. To prevent damage or injury, install ONLY specified replacement fuses with the amperage, voltage, and speed ratings shown in the specifications.

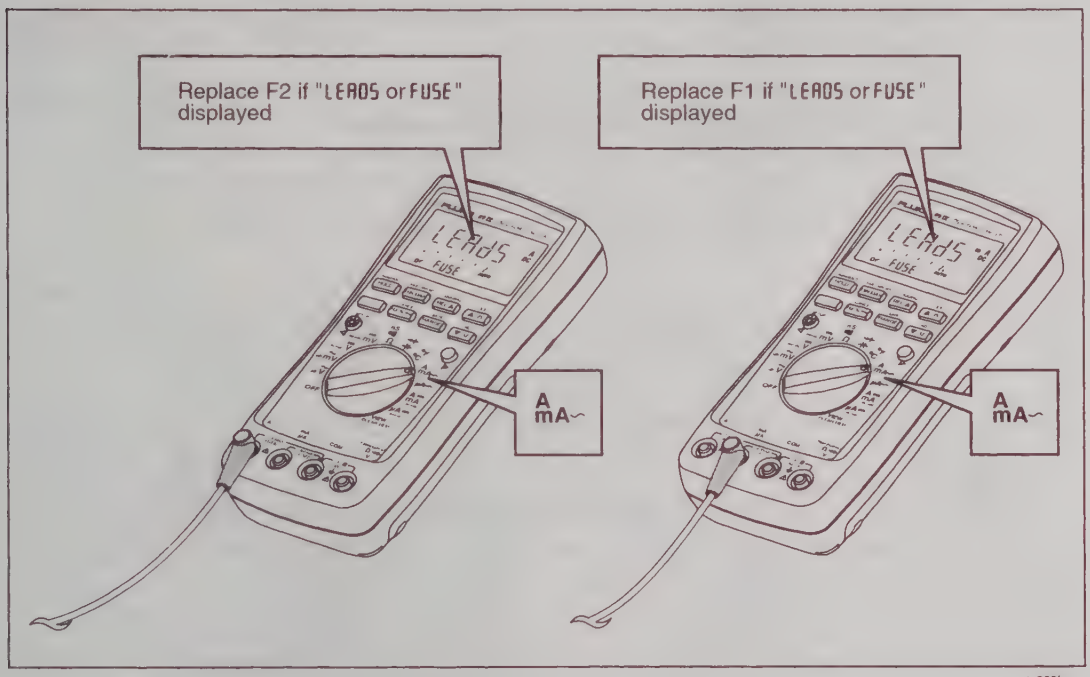


Figure 2. Testing the Current Fuses

Replacing Fuses

⚠Warning

To avoid electrical shock, remove the test leads and any input signals before replacing the battery or fuses. To prevent damage or injury, INSTALL ONLY specified fuses and batteries.

To replace the fuses, refer to Figure 3 and do the following:

1. Turn the rotary switch to **OFF** and remove the test leads from the terminals
2. Remove the battery access door by using a standard-blade screwdriver to turn the battery door fasteners one-quarter turn counterclockwise.
3. Remove either fuse by gently prying one end loose, then lifting the fuse out of the fuse contacts.
4. Install ONLY specified fuses.
5. Reinstall the battery door. Secure the door by turning the fasteners one-quarter turn clockwise.

Replacing the Batteries

The Meter is powered by four AA batteries (NEDA 15A or IEC LR6).

Caution

Be sure to observe proper polarity when replacing batteries. Incorrect battery polarity may seriously damage the Meter.

To replace the batteries, refer to Figure 3 and do the following:

1. Turn the rotary switch to **OFF** and remove the test leads from the terminals.

2. Remove the battery door by using a standard-blade screwdriver to the turn the battery door fasteners one-quarter turn counterclockwise.
3. Replace the batteries, observing proper polarity. Replace the battery door and secure it by turning the fasteners one-quarter turn clockwise.

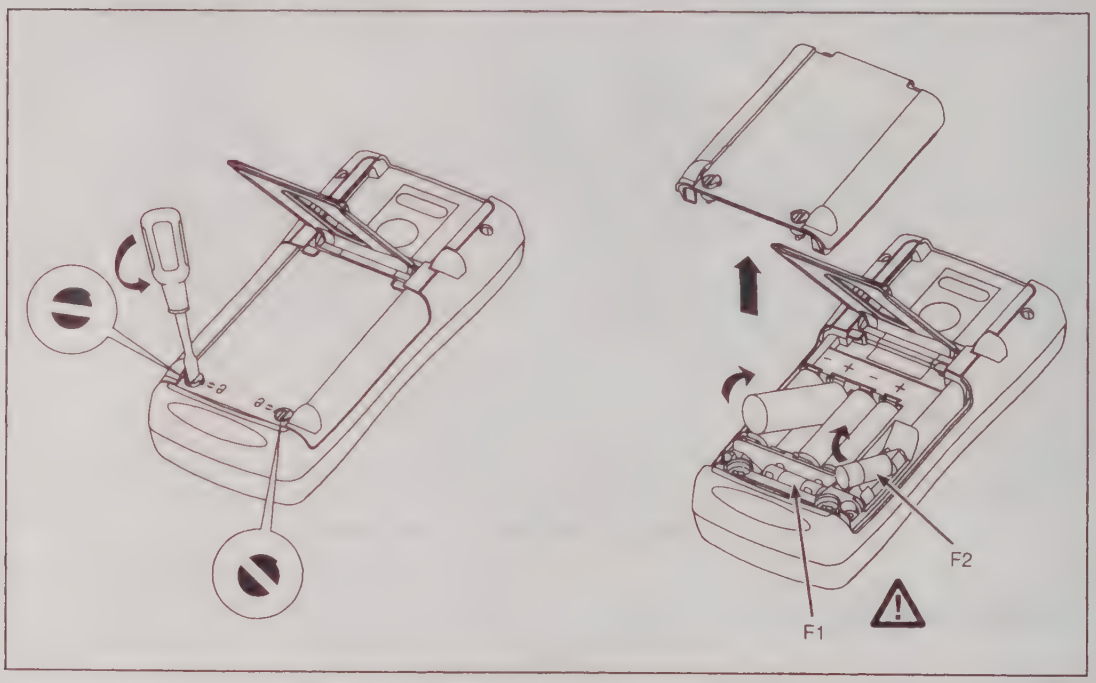


Figure 3. Battery and Fuse Replacement

Cleaning

⚠Warning

To avoid electrical shock or damage to the Meter, never allow water inside the case. To avoid damaging the housing, never apply solvents to the Meter.

Periodically wipe the case with a damp cloth and mild detergent. Do not use abrasives or solvents.

Dirt or moisture in the input terminals can affect readings and can falsely activate the Input Alert™ feature. Clean the terminals as follows:

1. Turn the Meter off and remove all test leads.
2. Shake out any dirt that may be in terminals.
3. Soak a new swab with alcohol. Clean each terminal with the swab.

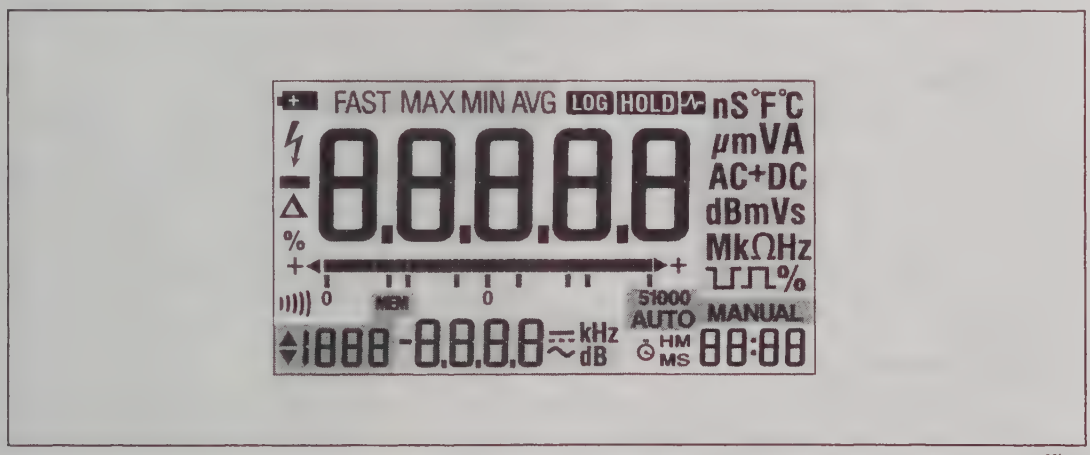
Performance Tests

The following performance tests will ensure that the Meter is in proper operating condition and will check the accuracy of each meter function against its specifications. To perform the tests you will need a Fluke 5520A Calibrator or equipment meeting the minimum specification given in Table 1.

If the Meter fails any of these tests, it needs calibration adjustment or repair.

Testing the Display

Push down the [HOLD] button and simultaneously turn the Meter on. Compare the display with the example in Figure 4. Check all segments for clarity and contrast.



aau02f.eps

Figure 4. Display Test

Backlight Test

To test the backlight, press the ☼ button twice. Note that the backlight comes on at two different intensity levels.

Current Terminal Sensing Test

This test determines whether or not the Input Alert™ beeper is functioning properly.

Note

Before conducting this test, make sure the beeper is not disabled in setup.

1. Turn the rotary switch to the AC V function. Press the backlight button twice to turn the backlight to the highest intensity.
2. Turn the rotary switch to all functions, except current functions. Note that the beeper does not come on.
3. Turn the rotary switch to the DC mA position. Insert a test lead into the mA terminal. Note that the beeper does not emit a continuous chirp.

Note

As the test lead is inserted, the Meter may produce a single chirp. This is acceptable.

Keypad Test

To test the keypad, turn the Meter to AC V and push each button separately. Each button push should cause the Meter to beep.

Reset the Meter by turning it **Off**, and then back **On**.

Verification of the IR Communication Port

Note

If you are using MET/CAL to do performance testing, it is not necessary to perform this verification test.

1. Connect the Infrared (IR) adapter to the com port of a PC.
2. Align the Meter IR port with the IR adapter window. Turn the Meter rotary switch to DC V.
3. Install Fluke 87/89 IV Service Software, P/N 676152.
4. Apply 1 V dc to the **VΩ⊣⊢** input terminal.
5. The display reading should appear in text box of PC.

Note

If the PC indicates that the Meter is not connected, ensure that the com port is correct and that the IR adapter is aligned with the IR window.

Testing Temperature

Connect K-type thermocouple and Fluke 80Ak to the temperature input on the Meter. Connect the other end to the 5520A TC output. Allow connections to stabilize for 30 seconds before proceeding.

1. Turn the rotary switch to the temperature function.
2. Set the 5520A for K-type thermocouple and an output of 23 °C.
3. Enter the Meter Setup mode (press yellow button, then backlight button).
4. Adjust the temperature offset until the temperature on the Meter primary display matches the 5520A output temperature (23 °C). Use the blue shift button and backlight button to advance digit. Use the up and down arrow keys to edit digit.
5. Enter an offset value by pressing the yellow button, then the backlight button.
6. Exit Setup mode by pressing the yellow button, then the **CANCEL** button.
7. Perform the steps in Table 3.

Table 3. Temperature Test Input and Display

Input	Display	
	Lower Limit	Upper Limit
-10.0 °C	-11.1 °C	-8.9 °C
0.0 °C	-1.0 °C	1.0 °C
350.0 °C	345.0 °C	355.0 °C

Testing Voltage, Current, Resistance, Capacitance and Diode Functions

To verify the accuracy of Meter functions, do the following.

1. Connect the Calibrator to the **VΩ→⊣** and **COM** inputs on the Meter.
2. Turn the rotary switch to the function listed in each step.
3. Apply the input from the steps listed in Table 4.
4. Compare the reading on the Meter display with the display reading in Table 4.
5. If the display reading falls outside of the range shown in Table 4, the Meter does not meet specification.
6. Repeat steps 2 through 4 for the remaining inputs shown in Table 4.

Table 4. Performance Test Steps

Step	Function	Range[1]	Input Level	Frequency or Model	Display[2]	
					Lower Limit	Upper Limit
1	AC V	5.0000 V	0.25 V	100 kHz	0.2310	0.2690
2	AC V	5.0000 V	5 V	20 kHz	4.9210	5.0790
3	AC V	5.0000 V	5 V	100 kHz	4.6960	5.3040
4	AC V	50.000 V	50 V	700 Hz	49.760	50.240
5	AC V	50.000 V	50 V	20 kHz	49.210	50.790
6	AC V	50.000 V	50 V	100 kHz	46.960	53.040
7	AC V	500.00 V	500 V	65 Hz	497.60	502.40
8	AC V	1000.0 V	500 V	65 Hz	494.0	506.0
9	AC mV	500.00 mV	500 mV	10 kHz	474.60	525.40
10	AC mV	3000.0 mV	3 V	20 kHz	2951.0	3049.0
11	AC mV	3000.0 mV	3 V	100 kHz	2816.0	3184.0
12	Frequency	50.000 kHz	1 V	20 kHz	19.998	20.002
13	Duty Cycle	3.1000 V	2.2 Vp-p, @30% Sq. wave	500 Hz	29.63	30.37
14	DC V	5.0000 V	short		-0.0010	0.0010
15	DC V	5.0000 V	5 V		4.9977	5.0023
16	DC V	5.0000 V	-5 V		-4.9977	-5.0023
17	DC V	50.000 V	-50 V		-49.982	-50.018
18	DC V	500.00 V	-500 V		-499.48	-500.52
19	DC V	1000.0 V	-500 V		-499.3	-500.7

1. Do not rely on autoranging for all tests. Some test steps will require manual ranging.
2. Must allow for source and meter settling before recording reading.
3. Wait at least 60 seconds for source and meter to settle before recording reading.
4. Using Relative Mode (REL) to zero residual reading (apply 0 Ω and allow UUT to settle for 45 seconds before pushing REL).

Table 4. Performance Test Steps (cont.)

Step	Function	Range[1]	Input Level	Frequency or Model	Display[2]	
					Lower Limit	Upper Limit
20	AC&DC	50.000 V	50 V	20 kHz	46.960	53.040
21	DC mV	500.00 mV	0 V		0.02	0.02
22	DC mV	500.00 mV	500 mV		499.83	500.17
87 IV and 89 IV test limits are different for 3000.0 dc mV range						
23	DC mV	3000.0 mV	+2 V	87 IV	1998.5	2001.5
				89 IV	1999.0	2001.0
24	DC mV	3000.0 mV	-3 V	87 IV	-2998.2	-3001.8
				89 IV	-2998.7	-3001.3
25	AC+DC	3000.0 mV	1 V	20 kHz	946.0	1054.0
Connect 5520A for 2 Wire Comp						
26	Ohms	500.00 Ω	0 Ω[3, 4]		-0.10	0.10
27	Ohms	500.00 Ω	500 Ω		499.65	500.35
28	Ohms	5.0000 kΩ	5 kΩ		4.9973	5.0027
29	Ohms	50.000 kΩ	50 kΩ		49.973	50.027
30	Ohms	500.00 kΩ	500 kΩ		499.73	500.27
31	Ohms	5.0000 MΩ	5 MΩ		4.9921	5.0079
32	Ohms	30.000 MΩ	30 MΩ		29.696	30.304
Remove 2 Wire Comp						
33	nS	50.00 nS	open		0.00	+0.10
34	nS	50.00 nS	100 MΩ		9.80	10.20
Remove Test Leads from UUT						
35	Capacitance	1.100 nF	open		<0.070	
36	Capacitance	110.0 nF	0.1 uF		98.5	101.5
37	Capacitance	11.00 uF	5 uF		4.90	5.10
38	Diode Test	3.1000 V	1 kΩ		0.6000	0.8000
39	AC mA	50.000 mA	2.5 mA	1 kHz	2.461	2.539
40	AC mA	400.00 mA	329 mA	10 kHz	323.96	334.04
41	AC uA	500.00 uA	500 uA	1 kHz	496.05	503.95

1. Do not rely on autoranging for all tests. Some test steps will require manual ranging.
2. Must allow for source and meter settling before recording reading.
3. Wait at least 60 seconds for source and meter to settle before recording reading.
4. Using Relative Mode (REL) to zero residual reading (apply 0 Ω and allow UUT to settle for 45 seconds before pushing REL).

Table 4. Performance Test Steps (cont.)

Step	Function	Range[1]	Input Level	Frequency or Model	Display[2]	
					Lower Limit	Upper Limit
42	AC uA	5000.0 uA	1.5 mA	1 kHz	1488.2	1511.8
43	DC mA	50.000 mA	0 A		-0.010	0.010
44	DC mA	50.000 mA	50 mA		49.915	50.085
45	DC mA	50.000 mA	-50 mA		-49.915	-50.085
46	DC mA	400.00 mA	-329.00 mA		-328.49	-329.51
47	DC uA	500.00 uA	500 uA		498.55	501.45
48	DC uA	-500.00 uA	-500 uA		-498.55	-501.45
49	DC uA	5000 uA	-5 mA		-4987.3	-5012.7
50	DC uA	500.00 uA	Short		-0.02	0.02
51	AC A	5.0000 A	250 mA	1 kHz	0.2422	0.2578
52	AC A	5.0000 A	250 mA	20 kHz	0.2310	0.2690
53	DC A	5.0000 A	0 A		-0.0010	0.0010
54	DC A	5.0000 A	5 A		4.9740	5.0260
55	DC A	-5.0000 A	-5 A		-4.9740	-5.0260
56	DC A	10.000 A	-6 A		-5.968	-6.032
57	AC A	10.000 A	6 A	1 kHz	5.905	6.095

1. Do not rely on autoranging for all tests. Some test steps will require manual ranging.
2. Must allow for source and meter settling before recording reading.
3. Wait at least 60 seconds for source and meter to settle before recording reading.
4. Using Relative Mode (REL) to zero residual reading (apply 0 Ω and allow UUT to settle for 45 seconds before pushing REL).

Calibration

Calibrate the Meter once a year to ensure that it performs to specifications.

Before you begin the calibration procedure, locate the recessed calibration button on the back of the Meter, underneath the accessory mount. It is inside a small opening covered by a seal. Carefully puncture the seal with a calibration tool to access the calibration button. See Figure 5.

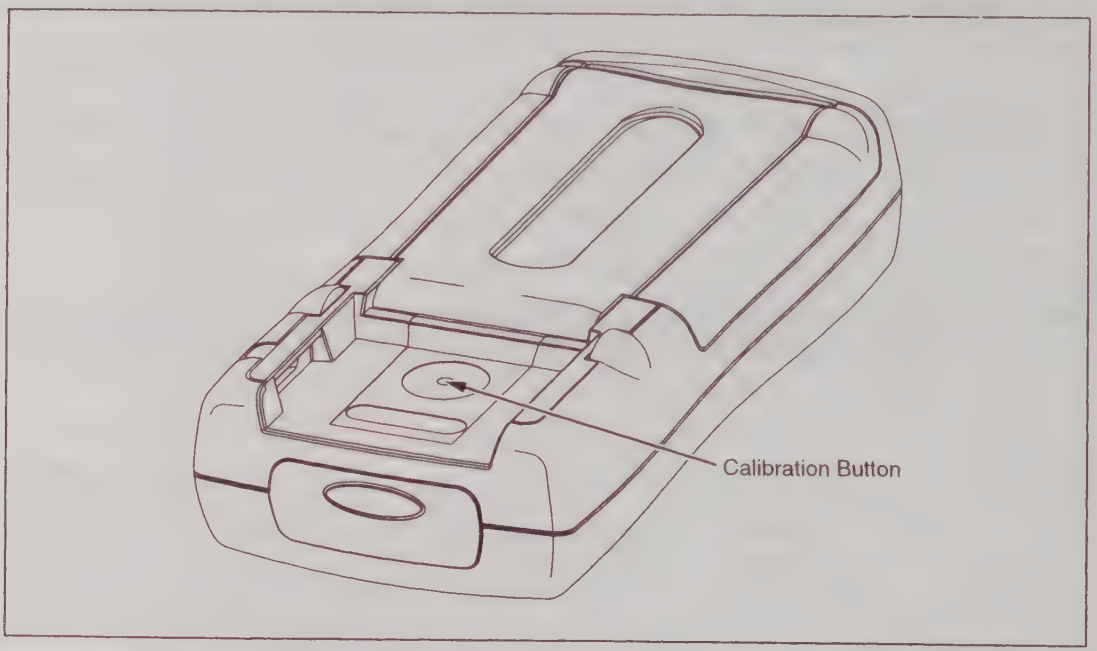


Figure 5. Locating Recessed Calibration Button

Keypad Interface

To start the calibration procedure, turn the rotary switch to the DC mV position, then press and hold the recessed calibration button on the back of the Meter for one second. This places the Meter in calibration mode as shown on the display in Figure 6. The unit will remain in the calibration mode until the rotary switch is moved to the **OFF** position.

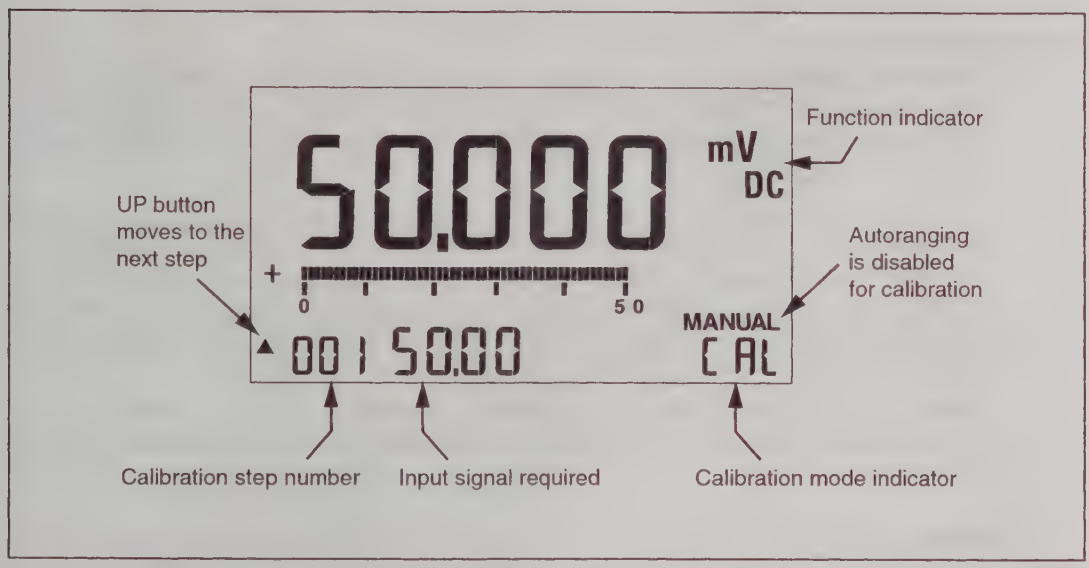


Figure 6. Calibration Display

General Procedure

A sequence of signal inputs is required for each function that must be calibrated. The secondary display shows the required input next to the step number for that function. The primary display shows the value being measured. The measurement is likely to be slightly different from the applied signal, because it may be showing an uncalibrated measurement. The general calibration procedure is as follows:

1. Move the rotary switch to the function that you are calibrating.
2. Apply the input signal indicated by the secondary display.
3. Wait for the measurement on the primary display to settle out to its final value.
4. Press the **UP** button to proceed to the next step. The Meter records a new constant.
5. Repeat steps 2 through 4 until the secondary display shows **End**. This indicates that the calibration procedure for this function is complete. New constants will not be recorded until secondary display shows **End**.
6. If there are more functions to be calibrated, move the rotary switch to the appropriate function, and continue from step one. Otherwise, turn the rotary switch to the **OFF** position to exit calibration.

Note

DC mV calibration affects the calibration of ALL functions and AC mV will affect all AC functions.

If the accuracy of the calibration source is more than approximately 15 % from the nominal value required for the cal point, then the factory default cal constants will automatically be used instead of source value. In this case, the Meter may not pass the verification test and may require re-calibration.

Special Requirements

DC mV calibration will affect the calibration of all other functions. Therefore, the DC mV function must be calibrated before calibrating any other function. Similarly, AC mV must be calibrated before any AC function, but after DC mV. The remaining functions may be calibrated in any order.

Temperature calibration need only be performed if one of the following components are replaced during the course of repair: U4 A/D chip, U10 EEPROM, or U100 Reference Junction Sensor. Temperature is calibrated by making an external temperature measurement and entering the result into the instrument for calculation of the calibration constant. The calibration constant is then stored in calibration memory. This is done using the serial interface. See "Temperature Calibration" section.

When you replace the U10 EEPROM, you must also re-enter the serial number and model number for the Meter. See "Reprogramming Meter Serial Number and Model Number" section.

Calibration Inputs

Table 5 lists the input values required for each calibration step.

Note

The column indicating time to settle does not include calibrator settling time.

Table 5. Calibration Inputs

Step	Value	Frequency	Time to Settle (In Seconds)
DC mV			
1	50 mV	DC	16
2	300 mV	DC	7
3	500 mV	DC	7
4	3000 mV	DC	1
Temperature			
1	0		1
AC mV			
1	500 mV	700 Hz	7
2	300 mV	700 Hz	7
3	100 mV	700 Hz	7
4	50 mV	700 Hz	7
5	3000 mV	700 Hz	7

1. Use 5520A 2-Wire Comp.
2. Zero ohms must use the same calibrator and test leads as all other ohm cal points. **Do not** bypass the calibrator with a shorting bar for the zero ohms step.
3. Because of capacitive coupling, readings will be affected by movement of the leads or operator. Put fingers on UP button and wait for display reading to settle before pushing.

Table 5. Calibration Inputs (cont.)

Step	Value	Frequency	Time to Settle (In Seconds)
AC V			
1	5 V	700 Hz	7
2	50 V	700 Hz	7
3	500 V	700 Hz	7
4	500 V	700 Hz	7
DC V			
1	5V	DC	7
2	50 V	DC	7
3	500 V	DC	7
4	500 V	DC	7
Ohms[1]			
1[2]	0 Ohms		16
2	500 Ohms		16
3	5k Ohms		7
Ohms			
4	50k Ohms		7
5	500k Ohms		7
6	5M Ohms		7[3]
7	30M ohms		1[3]
AC uA			
1	500 uA	700 Hz	7
2	5000 uA	700 Hz	7
DC uA			
1	500 uA	DC	16
2	5000 uA	DC	7
AC mA			
1	50 mA	700 Hz	7
2	400 mA	700 Hz	7
DC mA			
1	50 mA	DC	16
2	400 mA	DC	7

1. Use 5520A 2-Wire Comp.
2. Zero ohms must use the same calibrator and test leads as all other ohm cal points. **Do not** bypass the calibrator with a shorting bar for the zero ohms step.
3. Because of capacitive coupling, readings will be affected by movement of the leads or operator. Put fingers on UP button and wait for display reading to settle before pushing.

Table 5. Calibration Inputs (cont.)

Step	Value	Frequency	Time to Settle (In Seconds)
AC A			
1	5 A	700 Hz	7
2	5 A	700 Hz	7
DC A			
1	5 A	DC	16
2	5 A	DC	7

1. Use 5520A 2-Wire Comp.
2. Zero ohms must use the same calibrator and test leads as all other ohm cal points. **Do not** bypass the calibrator with a shorting bar for the zero ohms step.
3. Because of capacitive coupling, readings will be affected by movement of the leads or operator. Put fingers on UP button and wait for display reading to settle before pushing.

Remote Interface

You can perform semi-automated calibration with the remote interface using MET/CAL software. You must have a DB9 Adapter (Fluke P/N 804549) to operate the 87 & 89 Series IV meters with MET/CAL. This adapter allows you to connect the interface adapter to a PC. The DB9 Adapter and an Adapter Kit (Fluke P/N 689486) are required if you connect the UUT interface adapter to the 5520A serial port. For more information about MET/CAL calibration requirements, contact Fluke customer service.

Temperature Calibration

Required equipment:

- Fluke 87/89 IV Service Software, Fluke P/N 676152
- Infrared (IR) Adapter, Fluke P/N 690518
- IBM compatible PC
- Fluke 80T-150U with accuracy certified to ±0.2 °C
- Fluke 8060A Digital Multimeter

Optional equipment:

- Holster, IR Adapter, Fluke P/N 666443

Note

The following procedure is only required if the Meter has been repaired by replacing one of the following components: A/D, U4, Reference Junction Sensor, U100 or EEPROM, U10.

Setup

Prior to beginning the procedure, turn the rotary switch **OFF**. Let the Meter stabilize in a constant ambient temperature for 30 minutes. This allows the internal reference junction sensor and input terminals to stabilize to the same temperature.

Connect the IR adapter to the serial com port of the PC. Install the 87/89 IV Service Software.

Procedure

While the rotary switch is in the **OFF** position, insert the certified 80T-150 probe into the Meter's **COM** terminal (same temperature as reference junction). Make sure the probe tip makes firm contact with the bottom of the terminal. Measure and record the **COM** terminal temperature in units of 1/100 °C. Do not convert this number to Fahrenheit, even if the Meter is using the Fahrenheit scale for its display output.

Turn the rotary switch to the temperature position. It does not matter whether the Meter is in calibration mode. On the Service Software menu screen, click **°C Ref. Junction**. Enter the measured temperature value in the text box and click **OK**. This sends the recorded reference junction temperature to the Meter through the IR adapter.

Although the temperature calibration is not yet complete, it is safe at this point to turn the Meter off if the need arises. Doing so will not invalidate the previous steps.

To complete the temperature calibration, the DC mV function must be calibrated.

After DC mV calibration is complete:

1. Turn the rotary switch to the temperature position. Put the Meter in calibration mode by pressing the recessed button on the back of the Meter.

   The secondary display, which normally shows the required input, displays zero. In this case, no input is required.

2. Press the **UP** button.

   This sends the calculated temperature constants to EEPROM, and completes the temperature calibration.

3. Continue calibrating the other functions, or turn the rotary switch to the **OFF** position to exit calibration.

Re-Programming Serial Number or Model Number

When the U10 EEPROM is replaced, you must also reenter the serial number and model number for the Meter. Do this as follows:

1. Connect the IR adapter to the serial com port of the PC. Install Fluke 87/89 IV Service Software (Fluke P/N 676152).
2. Turn the Meter rotary switch to any function.
3. On the Service Software menu screen, click **EEPROM**. Enter the serial number from the back of the Meter in the text box and click **OK**. To enter the model number, click **Yes** or **No** in the model menu box.

Parts and Accessories

Replacement parts and accessories are listed in Table 6 and identified in Figure 7 by the reference designator.

Table 6. Replacement Parts and Accessories

Description	Reference Designators	Part Number	Qty
Access Door, Battery / Fuse	MP14	658446	1
Tilt-Stand	MP8	659026	1
Accessory Mount	MP9	658424	1
⚠Fuse, 0.44 A,1000 V, FAST	F1	943121	1
⚠Fuse, 11 A,1000 V FAST	F2	803293	1
Battery, 1.5 V, 0-150 mA, AA Alkaline	H8, H9, H10, H11	376756	4
Fasteners, Battery / Fuse Access Door	H12, H13	948609	2
Screws, Phillip-Head	H4, H5, H6, H7	832246	4
AC70A Alligator Clip (Black)	MP38	738047	1
AC70A Alligator Clip (Red)	MP39	738120	1
TL71 Right-Angle Test Lead Set	MP34	802980	1
LCD 4.5 Digit Multiplexed	DS1	688181	1
Connector, Elastomeric, LCD to PWB[1]	MP30, MP31	690883	2

⚠To ensure safety, use exact replacement only.

1. Order replacement connectors separately when ordering a replacement LCD.

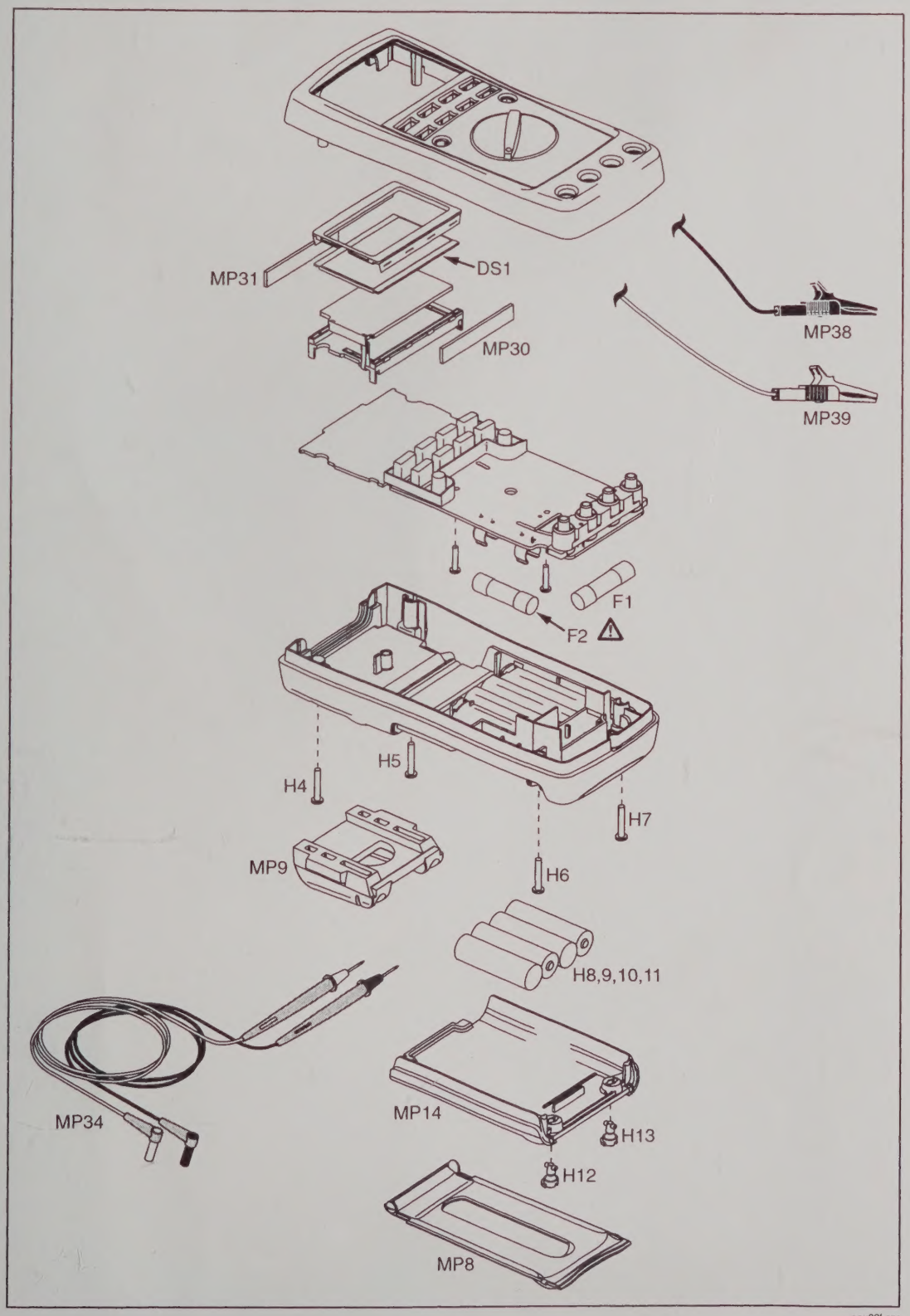


Figure 7. Replacement Parts and Accessories

MP MASTER
MA33051